

NOvA R&D Plan			WHO	Milestone Date for completion
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<b>PVC Samples</b>				
		<i>Near</i>		
		Procure PET = 1st extruder vendor (Prime=1st color house) baseline profile with additives removed, more TiO2	Fermilab	May-05
		Decide on "final" NOvA profile (notches, corner radius, end cell)	NOvA	July-05
		Analyze PET (Prime-additive) samples to confirm composition		
		Try a 2nd vendor (2nd color house?) with the final NOvA profile, 3 cells		
		Analyze 2nd vendor sample to confirm composition		
		Should we try anatase instead of rutile TiO2?		
		Should we try for smaller rutile particle size? Currently at 0.17 m so may need to investigate a "micronizer"		
		Try co-extrusion with black PVC at PET(=1st vendor) with baseline profile		
		Decide if we want / need co-extrusion		
		<i>Medium</i>		
		Seek at least one vendor for a 32-cell NOvA profile		
		Need to confirm final NOvA profile based on 2nd vendor experience		
		Procure enough 32-cell for several 8-plane blocks of a Near Detector?		
		Procure enough 32-cell x 51 ft for factory tests?		
		Analyze 32-cell sample to confirm composition		
		<i>Far</i>		
		Procure enough 32-cell for the Near Prototype (3.5m x 4.8m x 130 layers = 1872 m or ~ 6,100 ft)		
		Procure enough 32-cell for a full scale prototype? (25'x50'x40 layers = ~ 12,000 ft)		

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<b>PVC Tests</b>				
		<i>Near</i>		
		PET(Prime) and PET(Prime-additives) samples, test strength		
		PET(Prime) and PET(Prime-additives) samples, test creep		
		PET(Prime) and PET(Prime-additives) samples, IZOD impact		
		PET(Prime) and PET(Prime-additives) samples, test reflectivity	Indiana	
		PET(Prime) and PET(Prime-additives) samples, long term test in scintillator (PAC verbal question)		
		<i>Medium</i>		
		test samples from 2nd vendor, strength		
		test samples from 2nd vendor, creep		
		test samples from 2nd vendor, IZOD impact		
		test samples from 2nd vendor, reflectivity	Indiana	
		test samples from 2nd vendor, in scintillator		
		<i>Far</i>		
		test 32 cell samples, strength		
		test 32 cell samples, creep		
		test 32 cell samples, IZOD impact		
		test 32 cell samples, reflectivity	Indiana	
		test 32 cell samples, in scintillator		

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<b>PVC Structure Tests</b>				
		<i>Near</i>		
		Half-size prototype, 4 layers Extrutech at ANL. Assemble 2 layers flat, glue to 2 layers vertical	Argonne	
		Half-size FEA needed?		
		Pressurize half-size with water		
		Add more layers to the half-size prototype? What would we learn?		
		Construct smaller Extrutech prototypes, some with pressurized glued planes		
		Construct smaller PET prototypes, some with pressurized glued planes		
		Conduct tests of punched holes between cells? FEA?		
		Hire outside contractor to analyze our structure and search for missed failure modes		
		<i>Medium</i>		
		Expand Extrutech tests to more layers?		
		Conduct tests of Near Prototype 8-plane structure		
		<i>Far</i>		
		Test full size prototype (height anyway) somewhere?		

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		<b>PVC epoxies</b>		
		<i>Near</i>		
		Test Magnolia strength		
		Test Magnolia with scintillator		
		Look for alternates		
		Test alternates with scintillator		
		<i>Medium</i>		
		Decide on epoxy?		
		<i>Far</i>		

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			<b>Bottom Closure Parts</b>		
			<i>Near</i>		
			have prototype "saw-cut"		
			decide if an alternate design is needed (what basis?)		
			<i>Medium</i>		
			Decide on "final" design		
			<i>Far</i>		
			make 400 of one design		

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		<b>Top Manifold parts</b>		
		<i>Near</i>		
		prototype "clips"? (& test for fiber damage)		
		prototype design A		
		prototype design B		
		<i>Medium</i>		
		Decide on a "final" design		
		<i>Far</i>		
		make 400		

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			<b>Spiders</b>		
			<i>Near</i>		
			invent spider schemes, prototype "several", cost estimate		
			<i>Medium</i>		
			test the two "best" spider concepts in 48 ft. cells		
			<i>Far</i>		
			decide if spiders are necessary and affordable		

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Extrusion Module Assembly					
		Near			
			design factory		
		Medium			
			prototype any special tools?		
		Far			
			one factory to build 400 for prototype Near		



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	<b>Fiber</b>			
		<i>Near</i>		
		test 0.8 mm fiber in various % pseudocumene, extract lifetime for ourselves		
		test 0.8 mm fiber in NOvA home brew mix, extract lifetime		
		test lifetime of bent fibers		
		Look for alternate vendor?		
		<i>Medium</i>		
		<i>Far</i>		
		procure 66,000 meters for prototype Near Detector		

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<b>Scintillator</b>				
		<i>Near</i>		
		test samples of existing 4,000 gallons BC517L from NuTeV		
		more tests of home brew mixes? Need list		
		<i>Medium</i>		
		<i>Far</i>		
		procure 20,000 gallons (4 tanker trucks) from Bicron / Eljen?		
		procure 20,000 gallons (4 tanker trucks) mixed by _____		

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<b>APD work</b>				
		<i>Near</i>		
		initiate R&D agreement with Hamamatsu ==> 25 parts in summer 2007		
		get some bare die APDs		
		get some off-the-shelf packaged APDs		
		pursue alternate flex circuit design with bare die		
		<i>Medium</i>		
		procure flex circuits for alternate design		
		assemble and test flex circuits with bare die APDs		
		modify existing test boards with eye to using on prototype Near		
		<i>Far</i>		
		Decide on final scheme?		
		make 400 boards of some (or 2 x 200 ?) design for prototype Near		

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<b>ASIC work</b>				
		<i>Near</i>		
		finish MASDA' design	Fermilab	
		procure ~300 MASDA' chips (prototype Near needs 375) in engineering run		
		finish NOvA-specific RMC (Cockroft-Walton HV) design	Fermilab	
		procure ~300 RMC' chips (prototype Near needs 375) in engineering run		
		<i>Medium</i>		
		be prepared for another design round on both chips?		
		<i>Far</i>		

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			<b>Electronics Assembly</b>		
			<i>Near</i>		
			<i>Medium</i>		
			assembly of new circuits with MASDA', RMC', FPGA		
			<i>Far</i>		
			build 400 of a design compatible with Hamamatsu or Flex or off-the-shelf APD		

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	<b>Data Acquisition</b>			
		<i>Near</i>		
		Flesh out the proposal DAQ system with more detail?		
		Are there ways to do timing better than the 30 msec gate?		
		<i>Medium</i>		
		<i>Far</i>		
		Need protoype system for the 12,000 channel prototype Near detector		

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		<b>Light Yield tests</b>		
		<i>Near</i>		
		horizontal PET(Prime) and PET(Prime-additives) tests	Minnesota +?	
		vertical PET(Prime) and PET(Prime-additives) tests	Texas +?	
		test mock-up 3.8 x 6.0 cm cell from PET(Prime) stock		
		<i>Medium</i>		
		test light yield in 2nd vendor NOvA profile extrusion		
		test light yield in 32-cell NOvA profile extrusion		
		<i>Far</i>		
		repeat tests with updated electronics		

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Further Development of Far Detector Assembly Scheme, Time and Motion				
		<i>Near</i>		
		Does building design impact the assembly scheme?		
		<i>Medium</i>		
		<i>Far</i>		



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	<b>Far Site Block Raiser</b>			
		<i>Near</i>		
		full design, get as far as possible on R&D "\$"		
		<i>Medium</i>		
		<i>Far</i>		
		(I don't see funds for prototypes before "project")		

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	<b>Far Site Assembly Tables</b>			
		<i>Near</i>		
		full design, get as far as possible on R&D "\$"		
		<i>Medium</i>		
		<i>Far</i>		

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	<b>Epoxy Dispensing Machine</b>			
		<i>Near</i>		
		full design, get as far as possible on R&D "\$"		
		<i>Medium</i>		
		<i>Far</i>		

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Scintillator Filling "Cow"					
		Near			
			bubble tests need to test if bubbles matter, use PET(Prime-additives) sample with no TiO2?		
			prototype single channel device and use NuTeV scintillator to test it?		
			design a multichannel device		
		Medium			
			prototype multichannel device		
		Far			

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	<b>Bookend</b>			
		<i>Near</i>		
		<i>Medium</i>		
		<i>Far</i>		

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"NOvA" means  
official decision

## Bookend

*Near*

does a second bookend increase the detector lifetime?

final design(s)

*Medium*

*Far*

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			<b>Scintillator storage and distribution</b>		
			<i>Near</i>		
			storage tanks or just use the tankers themselves?		
			conceptual design of scintillator distribution system		
			<i>Medium</i>		
			design scintillator distribution system for final building		
			<i>Far</i>		

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	<b>Far Site</b>			
		<i>Near</i>		
		Site visit(s) in Spring 2005	Minnesota	April-05
		Site visit before or after MINOS at Ely?		
		Pick site(S)?		
		Characterize preferred site(S), ground radar, borings, water table, artifact search (summertime required)		
		explore ways to acquire site and access		
		Pick the final site		
		<i>Medium</i>		
		formalize lead entity to acquire site		
		Start Advanced Conceptual Design of Site Work		
		<i>Far</i>		
		Finish Advanced Conceptual Site Design		

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<b>Far Building</b>					
		<i>Near</i>			
			conceptual designs and costs for modest overburden	Fermilab	May-05
			conceptual designs for tanker storage building	Fermilab	May-05
			Decide on final concept w/wo overburden		
			Do we need a crane over the detector?		
		<i>Medium</i>			
			Start Advanced Conceptual Design of Site Work		
		<i>Far</i>			
			Finish Advanced Conceptual Building Design		
<b>Far Outfitting</b>					
		<i>Near</i>			
			conceptual design of rails?		
		<i>Medium</i>			
		<i>Far</i>			



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Simulations					
		Near			
			Understand muon energy resolution -- range, or energy from PH?		
			Explore if Michel electron signal is useful		
			Understand effect of cell size on QE proton recoil identification		
			Understand (1-y) efficiency for QE, Resonance, DIS event types		
			Understand efficiency vs. energy for QE, Resonance, DIS event types		
		Medium			
		Far			
			Compare to / learn from prototype Near Detector running in MINOS Surface Building		

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Background Studies						
		Near				
			Generate data samples for Near Detector at various underground positions			
			Blind test by another team to see if backgrounds can be untangled as in proposal			
			Interate varying systematics introduced from beam MC and neturino cross section uncertainties			
		Medium				
			Repeat blind test with LSND effect if confirmed by MiniBooNE in fall 2005			
		Far				

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			<b>Cosmic Ray Background Studies</b>		
			<i>Near</i>		
			Better model of photon background?		
			<i>Medium</i>		
			Generate "detector readout sample" including Cosmics and neutrino events? Some pictures might be good PR?		
			<i>Far</i>		
			Study with prototype Near Detector in MINOS surface building, different overburdens		

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<b>Prototype Near Detector in the MINOS Surface Building</b>				
		<i>Near</i>		
		Need a better cost estimate, how large a device can we afford?		
		<i>Medium</i>		
		<i>Far</i>		
		Operate a (12,000 channel ?) device		<b>March-07</b>
<b>Testbeam Work</b>				
		<i>Near</i>		
		<i>Medium</i>		
		<i>Far</i>		
		Use prototype Near Detector in MTest?		

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<b>Decommissioning</b>				
		<i>Near</i>		
		write down concept in a NOvA note		
		<i>Medium</i>		
		Need a complete plausible scheme in place for CDR?		
		<i>Far</i>		

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			<b>Conceptual Design Report</b>		
			<i>Near</i>		
			when do we need this in place?		October-05
			What is a CDR?		
			<i>Medium</i>		
			<i>Far</i>		
			<b>Technical Design Report</b>		
			<i>Near</i>		
			when do we need this in place?		March-06
			What is a TDR?		
			<i>Medium</i>		
			<i>Far</i>		